# Inbreeding Depression in Cage Populations of Drosophila

## by Jeffrey H. Simonson

*I inbred four generations of* Drosophila *using a sibmating system. Sibmating produced maximum inbreeding depression for demonstrating a linear fitness decrease. Sibmating pairs from the previous generation were allowed to reproduce in separate food vials. Fitness was measured by comparison to randomly mating pairs. Numbers of emerged adults in the third inbred generation did not vary significantly from the control pairs. Inbreeding depression dio not occur.*

### Introduction

Populations of sexually reproducing organisms rarely breed randomly. Even in large, well dispersed populations, proximity between mates may increase the probability of mating between related individuals. Under these non-random conditions, fitness may decrease due to increased homozygosity and expression of deleterious recessive alleles. In captive populations, this depression may indeed be significant. This experiment purports to demonstrate a linear relation between the degree of inbreeding and its associated fitness depression.

Maximum inbreeding for sexually reproducing organisms can be obtained by mating of full sibs (brother and sister). Figure 1 shows a sibmating pedigree beginning with wild unrelated parents A and B.

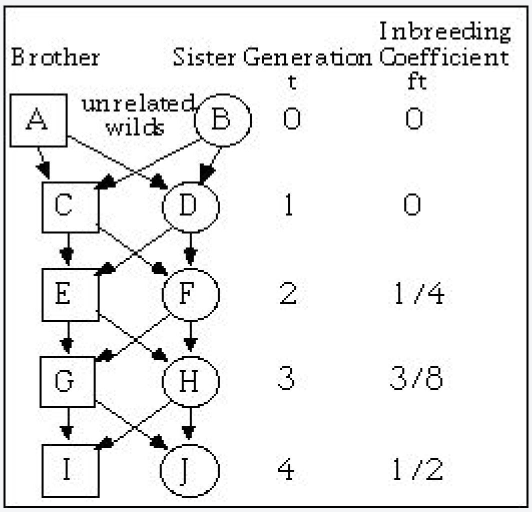


**Figure 1. Sibmating pedigree starting with unrelated wild parents (t = 0). The inbreeding coefficient ($f_t$) is calculated using Equation 1.**

The degree of inbreeding is indicated by the inbreeding coefficient ($f_t$). It is the probability of two homologous alleles at generation *t* being identical by descent. The average inbreeding coefficient of offspring under a regular system of sibmating is (Spiess 1977, p. 261):

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ft = 1/4 + 1/2ft-1 + 1/4ft-2 (1)
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Since generations *t* = 0 and *t* =1 can have no alleles identical by descent, all other values of $f_t$ can be calculated using equation (1). Fitness can be shown related to the inbreeding coefficient by the following derivations. Mean fitness (*w*) for an inbreeding population is (Weaver and Hedrick 1992, p. 581):

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winbreeding = 1 - sp2 - spqft (2)
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where:

*s* = selective disadvantage coefficient,

*p* = frequency of allele $A_1$, and

*q* = frequency of allele $A_2$.

Substituting the mean fitness for a randomly mating population (Weaver and Hedrick 1992, p. 562):

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wrandom = 1 - sq2 (3) and k = spq (4)
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into equation (2) gives:

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winbreeding = wrandom - kft (5)
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Therefore, from equation (5), fitness should decrease linearly as the probability of having an identical allele by descent increases.

## Methods

Flies were used both to begin the sibmating and as control populations. All mating pairs were put in separate food vials containing yeast and commercial fly feed, and kept at room temperature. They were allowed to mate for 10 days. Emerging adults were removed and counted every 12 hours to prevent the offspring from mating.

As shown in Figure 1, the unrelated wild virgin pair AB started the sibmating process. Virgin breeding pairs for each successive generation were selected from the offspring of the previous generation. Two to four redundant pairs were bred for each generation, but only one of these redundant populations were used to spawn the successive generation. Two to four wild virgin control pairs were also bred for generations were $f_t > 0$.

## Results

Figure 2 shows results for generation *t* = 3. Data for generations *t* = 2 and *t* = 4 are unavailable. Emerging adult *Drosophila* from both the inbred line and the control populations are shown. Offspring from three breeding pairs exist for each column.

The means of these two populations do not differ by more than two standard errors.

| Figure 2. Missing | Figure 2. Emerged offspring for three pairs of generation *t* = 3, and three pairs of control populations. |
|---|---|

## Discussion

The number of offspring of the inbred population does not vary significantly from the wild control populations. Thus, this experiment shows no inbreeding depression. Furthermore, since data for three or more generations could not be collected, no indication of a linear relationship between the inbreeding coefficient and fitness can be inferred.

In truly wild populations, though, inbreeding depression is demonstrable. Three other researchers have shown a decrease in viability for wild populations of *Drosophila*. For $f_t = 1/4$, they found viability decreases of 12% (Mettler 1966), 15% (Dobzhansky 1963), and 25% (Malogolowkin 1964).

Conversely, the lack of inbreeding depression has also been demonstrated in captive populations. The first inbreeding study showed no fertility decrease in strains in which selection for fertility was practiced in each generation (Dobzhanzky 1963). Falconer (1960) had one line survive 20 generations of sibmating without a viability decrease. Hyde (1924) concluded depression could not be considered as invariably associating with inbreeding after he found high fertility in some lines of *D. melanogaster.* Spiess (1977, p. 276) states, "Surviving lines are likely to harbor genotypes that have resisted the inbreeding depression and will thus be a selected group in which the linearity will no longer apply".

## Conclusions

The linear reduction in fitness of *Drosophila* by inbreeding depression is not supported by this study. No decrease in fitness occurred. This is possibly due to inbreeding immunity.

## Literature Cited

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